AI-enabled adaptive learning approach for E-Learning Environment, Learners' Engagement and Higher Education Students' Performance- A Study of Universities of Uttarakhand

A

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Candidate's Declaration

I, **Amit Das**, declare that the synopsis entitled, "**AI-enabled adaptive learning approach for E-Learning Environment, Learners' Engagement and Higher Education Students' Performance- A Study of Universities of Uttarakhand"** being submitted in the partial fulfillment of the requirement for the award of the degree of Doctor of Philosophy in Management under ICFAI Business School, The ICFAI University, Dehradun during the academic year 2022-23.

It is the work that is expected to carry out under the supervision of Dr. Sanjeev Malaviya. It is further declared that the synopsis is within the plagiarism limit and copy of the same is attached as per the University norms.

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Abstract

AI-enabled adaptive learning approach for E-Learning environment, Learner's Engagement and Higher education student's performance- Study of University at Uttarakhand

The modern online adaptive learning platforms have become exponentially popular among the leaners. It provides the personalized learning experiences for students based on their individual learning requirements and learning patterns. Simultaneously AI (Artificial Intelligence) is reframing the education with active pace and catering the e-learning platforms more convenience, accessible and flexible. The traditional e-learning systems often lack the ability to personalize content delivery and adapt to learners' needs, resulting in poor learner's engagement and low learner's performance. To evaluate the effectiveness of the adaptive learning approach, a pilot study will be conducted with a sample of learners from various higher education institutions established in Uttarakhand using an active e-learning platform. The study will compare the performance and engagement levels of learners who use the AI-enabled adaptive learning approach with those who use a traditional e-learning system.

The findings of this research will contribute to the development of more effective e-learning systems that can adapt to learners' needs and improve their engagement and performance. The aim of this research to propose the hypothetical model that integrates the AI enabled online adaptive learning to increase the learner's engagement and student performance. The research model can be used to study the impact of AI-enabled online adaptive learning on e-learning environment, learner's engagement, and learner's performance.

1. Introduction

Technology is giving extra pace to education and providing huge number of learning and teaching opportunity to the society with powerful tools. Modern teaching-learning tools are transforming learning curves in positive direction with more collaborative relationship between teachers and learners. The induction of IT technologies in education has changed the rhythm of teaching and learning globally with the concept of adaptive learning. Each student has their own learning needs and learning interest. The adaptive learning is a unique teaching and learning model and capable to design the custom learning program for each student. It adjusts the difficulty of task or assignment based on real time performance of the learner. The goal of adaptive learning is to customize the available contents or learning materials as per tracked requirement and progress of the learner with unique experiences, which is not possible in traditional teaching environment.

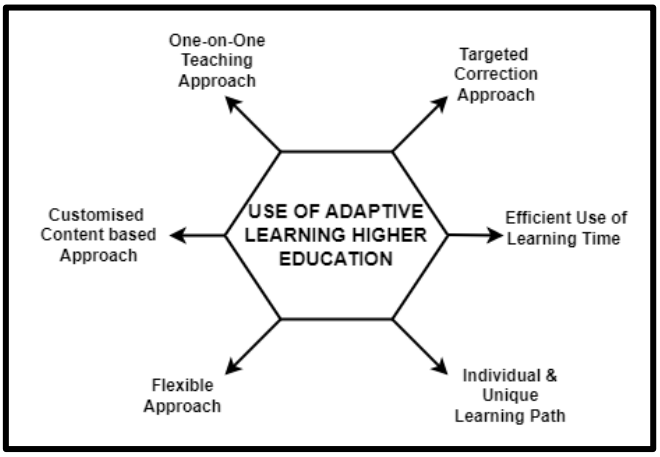
One-on-One Teaching Approach
Targeted Correction Approach
Customised Content based Approach
USE OF ADAPTIVE LEARNING HIGHER EDUCATION
Efficient Use of Learning Time
Flexible Approach
Individual & Unique Learning Path

Figure 1:Use of Adaptive Learning

The adaptive learning ecosystem is completely ICT (Internet and Communication Technology) oriented and strongly plug-in with web-based platforms. It is an e-learning system, provides the prompt assistance with required learning resources to learner and proper feedback system for learner to make the environment more personalized. The adaptive learning systems extensively collects the data about all the users and use that data to articulate the learner's strength, weakness and pattern of learning. The collected observations are used by the adaptive

system to fabricate the customised content, desirable learning activities and delivery of formative assessments to fulfil the learning sprit of each student. The personalized learning approach in adaptive learning is associated with constant evaluation of student's performance and readjustment of difficulty of learning material with unique real-time learning support system.

Benefits of Adaptive Learning Technology is as following: -

- Increases Learner's Engagement
- Upgrades Lerner's Learning Performances
- Personalized Learning Environment
- Gamification of Education
- Promotion of Technology in Education
- Searches best content for student
- Collaborate various concepts for required content
- Establish alignment between content and learner's learning capacity
- Optimize learning by providing recommendations
- Facilitator Driven Learning Environment

Adaptive learning systems are integrated platforms, which provides the strong connectivity between learning resources, devices, and exclusive capability of accessibility to the group of learners. It could be considered as the non-linear approach of teaching based on data-driven ecosystem to remodel the learning-track and learning-trend of student.

The E-learning environment and Adaptive Learning are often considered as complement to each other. Online education ecosystems deliver the supportive digital technologies and platforms required for the implementation of adaptive learning. The amalgamation of E-Learning and adaptive learning could create the personalized learning environment for each learner by tracing their learning progress and to fulfil their unique learning needs.

The adaptive learning based online platforms to subject instructors to effectively understand the student's learning needs and weaknesses. It also suggested to instructors to design most appropriate targeted support and interventions for the students. This facility could lead to better learning outcomes, as learners may able to receive learning support and guidance when they have required it most. The fusion of Online Education Platforms and Adaptive Technologies has massive strength to convert the learner's learning capabilities with improved achievement goals.

As per the *Statista Market Forecast,* there is a rapid growing pattern for adaptive learning and personalised learning with E-learning platforms encapsulated with Artificial Intelligence (AI) and Machine Learning (ML) to provide the customised learning approach. It is also forecasted that; this trend could develop the size of global market of $325 Billion by 2025 with approximate 7% of compound annual growth. The Adaptive Learning based Online Education with flexible learning solutions providing more personalized learning engagements.

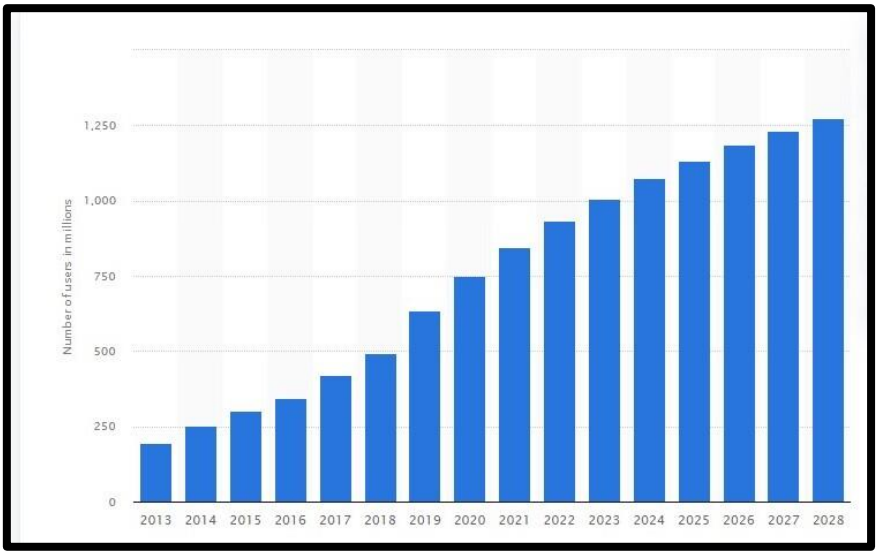

Figure 2: Internet Users in India 2013 to 2028 (Reference: https://www.statista.com/forecasts/1144044/internet-users-in-india)

In India the low-cost data, high speed internet and availability of smart phones in urban as well as rural area is promoting the E-Learning among the academic students or learners. The E-Learning platforms are presenting the geographical boundaryless opportunity to the students

without constraint of time based or any time learning motivation. The operational cost is lesser and resultant benefit of E-learning environment is higher than the traditional learning ecosystem.

The vast development in the field of AI is reframing the approach of adaptive learning and online education with more affirmative customisations. AI has ample potential to upgrade the adaptive learning-based E-learning platforms.

The potentials could be discussed under the following heads: -

- AI could analyse the learner's performance data to track the strength and weakness of student to suggest them appropriate learning content.
- AI could recommend additional learning materials based on learner's learning track and learning preferences.
- As per the learner's background the AI could reframe the prerequisites of the online course.
- AI could measure the student's real time performance accurately and constructs the feedback with in the course of time solution.
- AI could easily identify the knowledge gap and the level of learning difficulty of the learner by the intelligent evaluation of the assignments or practice sets.
- AI could draw the probability future performance based on the past learning records. It could give the early warning to the instructor about the student.
- AI could design learning map for each learner by the mapping of student progress and learning style simultaneously. It could alter the sequence and difficulty of content to optimize the learning outcomes.
- AI could provide the greater flexibility to students by allowing them to learn at their own learning pace based on customized learning path.

- AI controlled the adaptive learning online environment as per the unique learner's needs or environment.

The AI enabled adaptive learning environment for the E-Learning platforms play a significance role in enhancing the e-learning environments. By involving AI technologies, the enhanced personalized learning experiences created for each learner and e-learning platforms could be prepare for more engaging learning environment.

The Learner's engagement and adaptive learning is interlinked, the AI-Enabled Adaptive Learning Platforms could produce the better learner's engagement. It uses the learner's performance data and preferences to modify the learner's experience. This approach personalised the content as per the need of learner's interest and learning ability. Adaptive Learning could increase the learner's engagement by providing the personalised learning materials and learning activities. By enhancing the Learner's engagement, the AI enabled adaptive leaning online platforms could take student towards the better learning outcomes and learning satisfaction with unique learning experience and enhanced student performance.

2. Research Problem

The potential research problem that could be included for the research: -

1. How AI (Artificial Intelligence)-Enabled Adaptive Learning System could be used to personalized learning experiences for individual Lerner's for e-learning platforms and to improve the learner's engagement and performances?
2. What other considerations need to be taken into research when implementing AI-enabled adaptive learning approaches in higher education e-learning environments to enhance learner's engagement and performances and how effectiveness could be measured?

3. Literature Review

3.1 Motivation of Literature Review

- Adaptive learning and e-learning are two growing fields of education that have received a great deal of attention in recent years. Studies have shown that both adaptive learning and e-learning have a positive impact on student engagement and learning outcomes. Adaptive learning systems have been shown to increase student motivation, improve learning efficiency, and increase student achievement. E-learning has also been shown to have a positive impact on student engagement and motivation, as well as providing opportunities for self-paced and flexible learning.
- Some challenges also exist in the use of adaptive learning and e-learning. One of the main concerns is the issue of equity, as not all students have equal access to technology and internet resources. Another challenge is the need for high-quality educational content that is both engaging and effective in helping students learn.
- The integration of adaptive learning and e-learning have the potential to greatly improve the quality and effectiveness of education. While there are challenges to be addressed, the growing research in these areas suggests that they offer a promising future for education.

3.2 Methodology of Research Paper Review

- **Publication Consulted**

  For literature review the manuscripts are gathered from

  1. Articles from reputed journals
  2. Conference papers (International/National)
  3. Thesis

- **Key-word for searching**

  1. Adaptive Learning

2. Learner's Performance
3. Learner's Engagement
4. AI enabled Adaptive Learning
5. AI Enabled Adaptive Learning and E-Learning Environment

- **Research Data Base**

1. Google Scholar
2. Science Direct
3. Inderscience
4. Emarald
5. Taylor & Francis
6. Springer

- **Selection of Papers**

89 Research articles has been finally selected for the meta-analysis and systematic mapping process through the PRISMA approach.

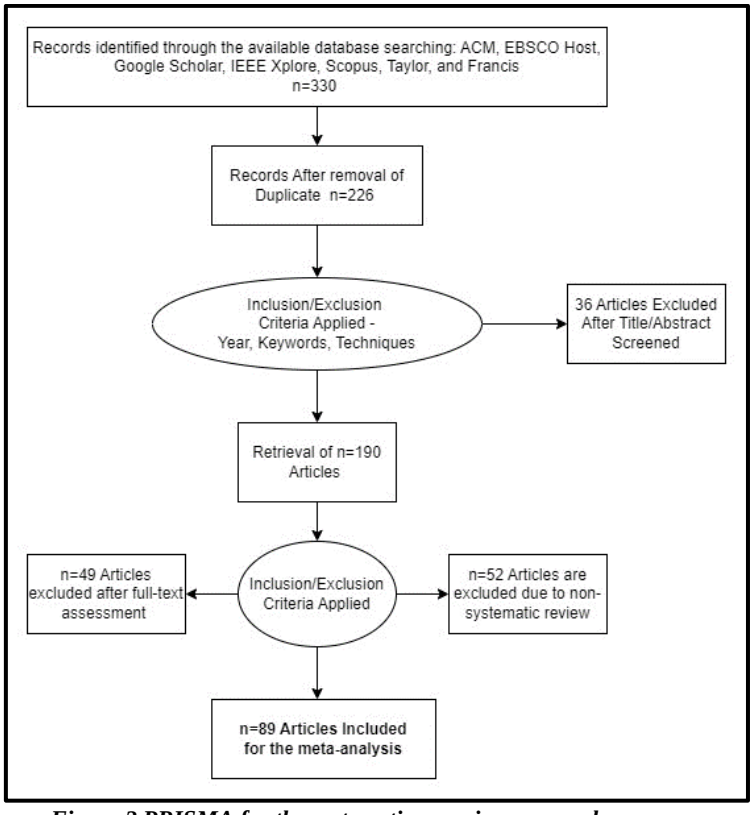
Records identified through the available database searching: ACM, EBSCO Host, Google Scholar, IEEE Xplore, Scopus, Taylor, and Francis n=330
Records After removal of Duplicate n=226
Inclusion/Exclusion Criteria Applied - Year, Keywords, Techniques
36 Articles Excluded After Title/Abstract Screened
Retrieval of n=190 Articles
n=49 Articles excluded after full-text assessment
Inclusion/Exclusion Criteria Applied
n=52 Articles are excluded due to non-systematic review
n=89 Articles Included for the meta-analysis

Figure 3 PRISMA for the systematic mapping approach

- **Highlights of Review**

1. Identify the AI models which is useful to enhance the learner's capabilities

2. Challenges of Adaptive Learning in the context of E-Learning
3. Major researches in AI enabled learning system and Adaptive learning
4. Systematic analysis of design for Adaptive Learning research
5. Review of different context, approaches and platforms for adaptive learning
6. To improve the understanding about Adaptive Learning and appropriate integration positions with AI frames.
7. Review of Lerner's Engagement for online adaptive learning system
8. Review of interconnection between Learner's Environments, Engagement & Performance.

3.3 Literature Review Matrix

The AI-enabled adaptive learning approach for E-learning environment has gained the greater attention from the various researchers of different domains to expand the learner's engagement and learner's performance.

The comprehensive literature review could present the following findings: -

Table 2: Literature Review Matrix

Author(s)	Title	Research Objective of Paper	Methodology	Key Findings
Lim et al. (2023)	Efficacy of an Adaptive Learning System on Course Scores	Articulate the impact of Adaptive Learning System on Learning outcomes of learner	Experimental Analysis	Use of Adaptive Learning platforms updated the performance of the learners
Jing et al. (2023)	Research Landscape of Adaptive Learning in Education: A Bibliometric Study on Research Publications from 2000 to 2022	Implementation and growth of Adaptive Learning Technology in Education Domain between 2000 to 2022	Literature Review	Article listed with positive effect of Adaptive Learning and its vast usability in delivery of quality education.
Park et al. (2023)	Adaptive or adapted to: Sequence and reflexive thematic analysis to understand learners' self-regulated learning in an adaptive learning analytics dashboard	To Analyze the challenges of feedback for the learner to adopt the suitable learning approach	Conceptual Analysis	Learners has always need the more diverse support from learning environment.
Oussous et al. (2023)	An Evaluation of Open Source Adaptive Learning Solutions	The Empirical evolution of all available open source	Systematic Study on Evolution of Technique	Provided the comparative matrix for different open source adaptive platforms.

		platforms for Edu-Tech		
Minn (2022)	AI-assisted knowledge assessment techniques for adaptive learning environments	To Study the relevance of personal instruction model in adaptive learning environment	Quasi-Experimental Approach	Trace the Potential approach for developing the knowledge assessment techniques in adaptive learning ecosystem
Trybulska et al. (2022)	Adaptive learning in university students' opinions: Cross-border research	Study the impact of Adaptive Learning Platform in University Education	Case Study	Provided some suggestion to improve the personalization for adaptive learning platforms in special reference to higher education.
Jorge et al. (2022)	Systematic Review of Adaptive Learning Technology for Learning in Higher Education	Systematic review of available articles of Adaptive Learning special reference to Higher Education	Literature Review	Provided the structured suggestion on usability of adaptive learning platforms in favor of higher education learners
Zamecnik et al. (2022)	Exploring non-traditional learner motivations and characteristics in online learning: A learner profile study	To do the study on learners motivation for online learning platforms	Experimental Study	Article is focused with learners profile to intercept the learners motivation for online learning
Rajabalee et al. (2021)	Learner satisfaction, engagement and performances in an online module: Implications for institutional e-learning policy	To study the relationship between learner satisfaction and learner engagement	Case Study	Positive correlation between learners satisfaction and engagement
Yousaf et al. (2021)	An intelligent content provider based on students learning style to increase their engagement level and performance	To study the impact of provided content to improve the learners engagement and performance	Experimental Analysis	There is a positive interconnection between the provided content, learner performance and learner engagement
Alam. (2021)	Possibilities and Apprehensions in the Landscape of Artificial Intelligence in Education	To explore the built-in capabilities of AI in the field of education	Survey	AI could change the approach of knowledge delivery and could sensitize the interlinking between AI and education.
Lee (2021)	Prediction of Student Performance in Massive Open Online Courses Using Deep Learning System Based on Learning Behaviors	To study the prediction method of student performances	Experimental Study	With the help of Adaptive Learning platforms the performance of learner could be predicted and improved.
Wei (2019)	Performance Comparison of an AI-Based Adaptive Learning System in China	To study the impact of AI based adaptive learning platforms in China	Case Study	Chinese learners are receiving the better performance by using Yixue adaptive learning system.
Mehigan (2019)	Modelling an holistic artificial intelligent education model for optimal learner engagement and inclusion	To study the use of AI to fulfill the special learning needs of students	Experimental Study	The AI-based system approach to handle the learners challenges
Miljanovic (2019)	Enhancing computer science education with	To study the student engagement in	Experimental Study	Adaptive learning platforms increases the student

	adaptive serious games	computer science through adaptive learning platform		performances
Koedinger and Aleven (2007)	Exploring the assistance dilemma in experiments with cognitive tutors	To explore the assistance dilemma in experiments with cognitive tutors	Experimental study	Providing too much assistance can hinder learning, while providing too little assistance can also hinder learning. Therefore, it is important to provide adaptive assistance based on learners' performance.
Baker and Yacef (2009)	The state of educational data mining in 2009: A review and future visions	To review the state of educational data mining in 2009 and discuss future directions	Literature review	Educational data mining can provide valuable insights into learners' behavior and performance, which can be used to improve instructional design and personalized learning.
Brusilovsky et al. (2014)	Adaptive navigation support in educational hypermedia: The role of student knowledge level and the case for meta-adaptation	To explore the role of student knowledge level in adaptive navigation support in educational hypermedia	Experimental study	Adaptive navigation support can improve learners' performance, especially for those with lower prior knowledge. However, meta-adaptation (i.e., adapting the adaptive system) is also important for optimal performance.
Huang et al. (2017)	An intelligent adaptive learning system for supporting location-based ubiquitous learning	To develop and evaluate an intelligent adaptive learning system for location-based ubiquitous learning	Design and experimental study	The intelligent adaptive learning system improved learners' engagement and performance, especially for those with lower prior knowledge.
Huang and Liang (2018)	An adaptive learning system for improving students' learning achievements in ubiquitous learning environments	To develop and evaluate an adaptive learning system for ubiquitous learning environments	Design and experimental study	The adaptive learning system improved learners' engagement and performance, especially for those with lower prior knowledge.
Alfalahi et al. (2017)	The effectiveness of an adaptive e-learning system in computer science education	To evaluate the effectiveness of an adaptive e-learning system in computer science education	Experimental study	The adaptive e-learning system improved learners' engagement and performance, especially for those with lower prior knowledge.
Vasilchenko et al. (2019)	Adaptive e-learning system for students with different cognitive styles: Experimental study	To develop and evaluate an adaptive e-learning system for students with different cognitive styles	Design and experimental study	The adaptive e-learning system improved learners' engagement and performance, especially for those with lower prior knowledge. The system was more effective for learners with certain cognitive styles (e.g., intuitive and reflective) than others (e.g., sensing and active).
Kay and Kummerfeld (2018)	Principles for Designing Neural Network-Based Learning Systems in Human-Centered AI	To explore principles for designing neural network-based learning systems in human-centered AI	Conceptual analysis	Designing neural network-based learning systems in human-centered AI requires considering ethical issues such as transparency,

				fairness, and accountability.
Tsai et al. (2018)	Effects of personalization and active participation in learning with educational robots	To investigate the effects of personalization and active participation in learning with educational robots	Experimental study	Personalization and active participation improved learners' engagement and performance, especially for those with lower prior knowledge.
Martin and van der Aalst (2020)	Ethical and legal aspects of educational data mining and learning analytics	To explore the ethical and legal aspects of educational data mining and learning analytics	Literature review	Educational data mining and learning analytics can raise ethical and legal concerns related to privacy, consent, transparency, and fairness.
Alshammari et al. (2020)	The effect of AI-based adaptive learning on students' engagement and performance.	Explore the effect of AI-enabled adaptive learning on learners' engagement and performance	Experimental study	The experimental group showed significant improvement in engagement and performance compared to the control group.
Fan et al. (2020)	A personalized learning system based on AI for primary school students	AI based personalized learning system to improve the learner's engagement and performance	Case Study	The personalized learning system improved student's engagement and performance and students reported high satisfaction with the system.
Feng et al. (2021)	AI-enabled adaptive learning approaches for online education.	Study the AI-enabled adaptive learning be used to enhance learner's engagement and performance in an online learning environment	Literature Review	AI-enabled adaptive learning can enhance learner's engagement and performance by providing personalized learning experiences, real-time feedback, and adaptive content delivery.
Kostopoulos et al. (2020)	Investigating engagement factors in adaptive educational technology environment	To intercept the factors that influence learner's engagement in AI-enabled adaptive learning	Survey	Learner's engagement in AI-enabled adaptive learning is influenced by personal characteristics, system features and pedagogical factors.
Liu et al. (2020)	A Quasi-Experimental study on the impact of chatbot in online learning engagement and performance.	Effect of AI-based chatbot enhance the learner's engagement and performance in an e-learning environment	Quasi-Experimental Study	The AI-enabled chatbot improved student's engagement and performance compared to traditional learning environment.
Wang et al. (2021)	AI-based personalized learning system for primary education: effects on learning motivation and performance.	Study of AI-based personalized learning system improve learner's motivation and performance.	Experimental Study	The AI-based personalized learning system improved learner's motivation and performance, and student reported high satisfaction with the system.
Li et al. 2021	An AI-enabled adaptive learning approach for enhancing learner engagement and performance.	Study on AI-Enabled adaptive learning approached	Conceptual Study	The AI-enabled platforms enhance the learner's engagement and learner's performances
Lee et al. 2021	Using AI for adaptive learning: A systematic review	Impact of AI-enabled online platforms on learner's need	Literature Review	The AI-enabled platforms upgrade the traditional approach of leaning
Chen et al. 2020	Impact of an AI-enabled adaptive learning approach on learner engagement and performance	The interrelation between learner's engagement and learner's performance	Case Study	The inter-linked nodes between the different variables of online learning

Jiang et al. 2019	Design and implementation of an AI-enabled adaptive learning approach	The study for implementation of AI-enabled adaptive online learning platforms	Experimental Study	The hypothetical framework has been proposed for the AI-enabled online learning platforms
Wang et al. 2021	Ethical issues in AI-enabled adaptive learning approaches	Demystify the different associated ethical issues with online platforms.	Conceptual Study	Ethical issues have been addressed to handle the AI-enabled learning platforms
Lee et al. 2021	Using AI for adaptive learning: A systematic review	The comprehensive usefulness of AI technologies for the online learning platforms	Survey	AI technologies required to develop or fabricated the AI enabled platforms to handle the unique need of the learner and the factors required to consider for the personalization of the learning environment.
Lin et al. 2018	The role of learner engagement in adaptive learning	Study of learner's engagement in online adaptive learning platforms	Comprehensive Study	The factors improve the learner's engagement and association between them.
Chen et al. 2021	Long-term effects of an AI-enabled adaptive learning approach	Interception of different variables in online adaptive learning	Literature Study	Enhancement of learner's learning capabilities by the engagement of various AI technologies
Kabudi et al. 2021	AI-enabled adaptive learning systems: A systematic mapping of the literature	Identifying and adopt the right type of AI-enabled learning techniques to address a specific learning challenge.	Literature Survey	The presented research on AI-enabled learning systems aims to improve understanding of learning systems.
Zahabi et al. 2019	Adaptive driving simulation-based training: framework, status, and needs.	Analysis of Non-adaptive simulator and its counter effects on learners	Analytical Study	The impact of adaptive learning-based simulators on learner's performance
Hou et al. 2016	A generic framework of intelligent adaptive learning systems: from learning effectiveness to training transfer	Investigating the evolution of Online adaptive learning and impact of AI	Experimental Study	Focused on the customised learning system
Delfino 2019	Student Engagement and Academic Performance of Students of Partido State University	To determine the student engagement of Partido State University and intercept the factors affecting the student performance	Case Study (Descriptive Correlation Method)	The strong collaboration between different learning factors could improve the student's engagement in higher education.
Ouyang et al. 2022	Artificial intelligence in online higher education: A systematic review of empirical research from 2011 to 2020	To comprehensive trace of AI technologies for online education	Literature Review	Impact of AI to track the learner's engagement, performance, customization of content, interactive learning environment etc.
Kailash 2022	IoT enabled e-learning system for higher education	To improve the online Lerner's participation with good degree of proficiency	Experimental Study	IoT enabled and AI supported online platforms could enhance the academic performances
Sdenka et al. 2022	Student engagement in online learning in Latin	To study the unexplored factors of	Case Study	There are various online learning factors or variables

	American higher education during the COVID-19 pandemic: A systematic review	student's engagement of Latin American Universities during through the online platforms		and improvement among them could enhance the student's engagement.
Minn 2022	AI-assisted knowledge assessment techniques for adaptive learning environments	Study the usefulness of AI enabled personalised instructional environment for adaptive learning platforms	Conceptual Analysis	The knowledge assessment of learner's could be improved by the intelligent adaptive platforms.
Anderson 2020	Cultivating Student Engagement in a Personalized Online Learning Environment	To study the challenges of flexible online platforms	Conceptual Analysis	The Data-Driven, Decision-making platforms could help the online platforms to adopt the best solution for the leraner.
Talyor 2021	Personalized and Adaptive Learning	To conduct the study between different factors of personalization and the adaptive learning	Case Study	The individual Lerner's attention could be improved by the deployment of adaptive learning techniques.
Khosravi 2020	Development and Adoption of an Adaptive Learning System Reflections and Lessons Learned	To study the customized learning experiences using dynamic adaptive online platforms	Quasi-Experimental Study	This is providing the insight of involving different intelligent educational tools by the appropriate customization of learning platforms
Alkabbany 2023	An Experimental Platform for Real-Time Students Engagement Measurements from Video in STEM Classrooms	To check the learner's engagement by the interrupting learning and teaching processes through the online environments	Experimental Study	The framework is presenting the better student performances by improving the behavioral and emotional engagements
Viola 2020	An Ontology for Universal Design for Learning	The study of ontology of content and it's model required for learner's	Conceptual Study	Recommended model to guarantee of learning and required content model
Kem 2022	Personalised and Adaptive Learning: Emerging Learning Platforms in the Era of Digital and Smart Learning	Study of different adaptive learning tools to enhance the learning approach of learner	Literature Review	Usefulness of adaptive learning tools to extend the learning capabilities of the learner
Kabudi 2021	Identifying Design Principles for an AI-enabled Adaptive Learning Systems	Study of AI enabled adaptive learning system preferences and needs for implementation	Experimental Design	Proposed hypothetical Design principles for AI enabled adaptive learning systems
Alam 2021	Possibilities and Apprehensions in the Landscape of Artificial Intelligence in Education	To study the capabilities of AI in the domain of Education and Learning	Literature Survey	The Paper presented the systematic study of the potential of AI enabled tools in education.
Sapountzi et al. 2019	Dynamic Knowledge Tracing Models for Large-Scale Adaptive Learning Environments	To study the large scale learner's data to trace the patterns	Quasi-Experimental Study	Presented the model to acquire the Lerner's performance track and learning track

Apoki et al. 2020	From Digital Learning Resources to Adaptive Learning Objects: An Overview	To study the available digital learning resources and it's advantage for online or virtual learning	Literature Review	Intercepted the use of hypermedia system to design the better adaptive learning platforms

Kovanović et al. (2019) found that an adaptive e-learning platform improved learners' knowledge acquisition and retention compared to a non-adaptive platform. Similarly, a study by Jovanović et al. (2018) found that an adaptive platform improved learners' exam scores. Tawfik et al. (2019) found that an AI-enabled adaptive learning platform significantly improved learners' critical thinking skills compared to traditional e-learning methods. Additionally, a study by Soni et al. (2020) found that an adaptive platform improved learners' problem-solving skill.

Drasgow et al. (2018) found that an adaptive platform increased learners' motivation to learn and reduced their frustration levels. Similarly, a study by Wang et al. (2021) found that an adaptive platform improved learners' engagement and satisfaction compared to a non-adaptive platform.

Wang et al. (2020) found that an AI-enabled adaptive platform improved learners' collaboration and communication skills. The platform achieved this by enabling learners to interact with their peers, share resources, and collaborate on assignments. Zou et al. (2020) found that an adaptive learning platform improved learners' test scores and knowledge retention compared to traditional e-learning methods. Similarly, a study by Thorne et al. (2019) found that an adaptive platform improved learners' critical thinking skills and their ability to apply concepts in real-world scenarios.

Li et al. (2021) found that an AI-enabled adaptive learning platform improved learners' programming skills compared to a non-adaptive platform. The platform provided personalized feedback to learners, enabling them to identify their strengths and weaknesses and tailor their

learning accordingly.

Jang et al. (2020) found that an adaptive platform increased learners' motivation and engagement levels compared to traditional e-learning methods. Similarly, a study by Phan et al. (2019) found that an adaptive platform improved learners' engagement and satisfaction with the learning experience.

Ahmed et al. (2021) found that an AI-enabled adaptive platform improved learners' social interaction and collaboration skills. The platform facilitated social learning, enabling learners to engage with their peers, share resources, and collaborate on assignments.

The literature review revealed that AI-enabled adaptive learning approaches have the potential to enhance learners' engagement and performance in online learning environments. These approaches provide personalized learning experiences, real-time feedback, and adaptive content delivery to learners.

The following subsections summarize the findings from the reviewed studies.

Effect on Learners' Engagement: Several studies found that AI-enabled adaptive learning approaches can enhance learners' engagement in online learning. For instance, Alshammari et al. (2020) found that an AI-based adaptive learning system improved learners' engagement compared to traditional instruction. Similarly, Fan et al. (2020) reported that an AI-based personalized learning system improved primary school students' engagement.

Factors Influencing Learners' Engagement: Kostopoulos et al. (2020) investigated the factors that influence learners' engagement in an AI-enabled adaptive learning environment. The study found that learners' engagement is influenced by personal characteristics, system features, and pedagogical factors. The personal characteristics include motivation, prior knowledge, and self-efficacy. The system features include adaptivity, interactivity, and feedback. The pedagogical factors include instructional design and learning outcomes.

Effect on Learners' Performance: Several studies also reported that AI-enabled adaptive learning approaches can improve learners' performance in online learning. Alshammari et al. (2020) found that an AI-based adaptive learning system improved learners' performance compared to traditional instruction. Similarly, Liu et al. (2020) reported that an AI-enabled chatbot improved learners' performance compared to traditional online learning.

Effect on Learners' Motivation: Wang et al. (2021) investigated the effects of an AI-based personalized learning system on primary school students' motivation and performance. The study found that the system improved learners' motivation and performance. The personalized nature of the system seemed to be particularly effective in promoting learners' motivation.

Factors Influencing Learners' Performance: Feng et al. (2021) conducted a literature review of AI-enabled adaptive learning approaches for online education. The review found that learners' performance is influenced by personal characteristics, learning environment, and learning outcomes. The personal characteristics include prior knowledge, motivation, and learning styles. The learning environment includes system adaptivity, interactivity, and feedback. The learning outcomes include learning achievement, knowledge retention, and skill acquisition.

4. Research Gap

The study of research gap for AI enabled adaptive system based on e-learning environment for learner's engagement and performance is required more comprehensive approach of study in diverse learning environment for diverse types of learners. Some of research papers suggests that the learner's performance and engagements could be improved through AI-enabled online adaptive learning system by the focusing various driver elements such as content analysis, customization of learning environment, continues evaluation of feedback and learning

outcomes.

The research gaps could be summarized as follows: -

Research Gap 1: Limited researches has been conducted on effectiveness of AI enabled online learning platforms for diverse learning contents and learning needs with different learner's population.

Research Gap 2: Most of the researches are oriented about the impact of AI enabled online learning approach on cognitive outcomes of learners rather than non-cognitive outcomes such as student's motivation and confidence.

Research Gap 3: Limited number of Researches on implementation and formulation of optimal design of AI enabled online leaning platforms.

Research Gap 4: Restricted number of researches has executed to integrate the AI-enabled adaptive learning approach with existing online teaching pedagogies.

5. Research Objective

The major objective of the research is as follows: -

- To do the comprehensive study of AI-enabled learning approach for the e-learning environment and it's influences to learner's performances and engagement with factors that could improve it.
- To explore the association between learner's engagements and learner's performances and simultaneously the impact of learner's engagement on performance outcomes of learner.
- To analysis of different demographic variables and their influences on learner's engagements and performances in respect to E-Learning Environment.

- To design and validate the model to address the impact of different demographic issues and identify various factors that improve the learner engagement and performances.
- To intercept the role of modern digital technology in improving the student engagement and performances and determine the probable learning challenges.

6. Proposed Research Model

The proposed research model is designed to evaluate the AI enabled adaptive learning e-learning platforms that can improve the learner's engagement and performances. The prosed research it as follows:-

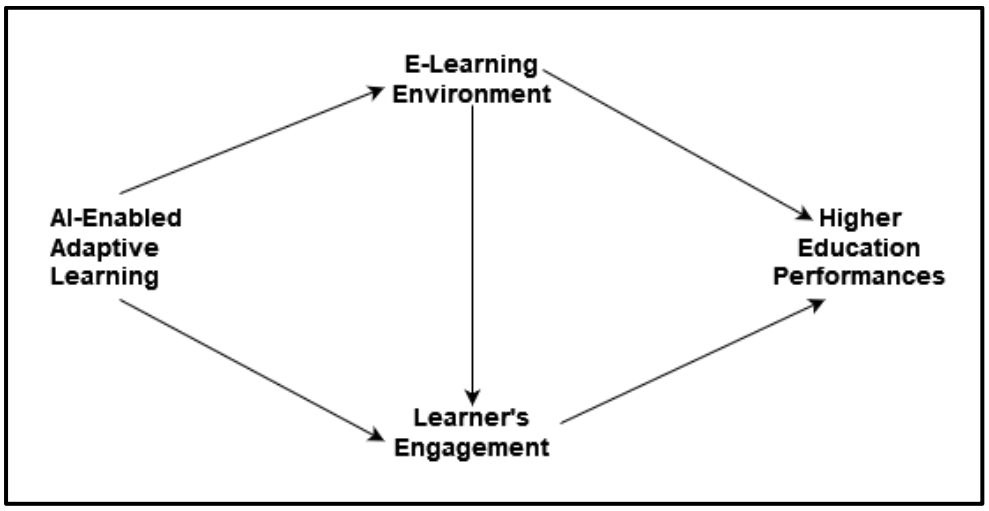

Figure 4 Proposed Research Model

7. Research Methodology

To investigate the proposed research model, a mixed-method research approach will be used to create solutions of research problems. The set of questionaries would to given to the e-learners to gather data. The collected quantitative data contained information about e-learner platform, learner's engagement, learner's performance, personalization of learning environment, real time feedback, interactivity, content delivery and technology. The Statistical tools will be used to test the proposed hypothesis and analyse the relationship between the

variables in the model and gather the deep knowledge about the e-learners experiences.

7.1 Research Framework

The complete research framework could be incorporated as follows:

- The research issues should be stated clearly with proper identification of research problems such as need to explore the effectiveness of AI-enabled adaptive learning systems for learner's engagement and learner's performance.
- Since the research will be completely based on established theories and concepts from outsourced from various research and conference papers on AI-enabled adaptive e-learning platforms and associated with learner's engagement and learner's performances.
- Simultaneously, it is also necessary to extract the benefits of e-learning platforms and adaptive learning approach in the domain of learner's engagement and learner's performance.
- Various key variables such as independent variables, dependent variables, mediating variables and moderating variables should be identified to establish the relationship between different nodes of research.
- The research framework could establish the articulated hypothesis that evaluate and test the association or degree of relationship between different identified variables.
- The framework should suggest the good research model to validate or test all the proposed hypothesises.
- The research framework would propose the data collection methods that should be used to collect the information and test the hypothesis and explore the association between variables.

- The research framework should suggest the appropriate data analysis or statistical analysis methods to execute analysis of the collected data.

The research framework should fabricate the outline to present the research report and publication of research papers. The conclusions that extracted from the analysis of data will encapsulate the recommendations for enhancing the learner's engagement and performances.

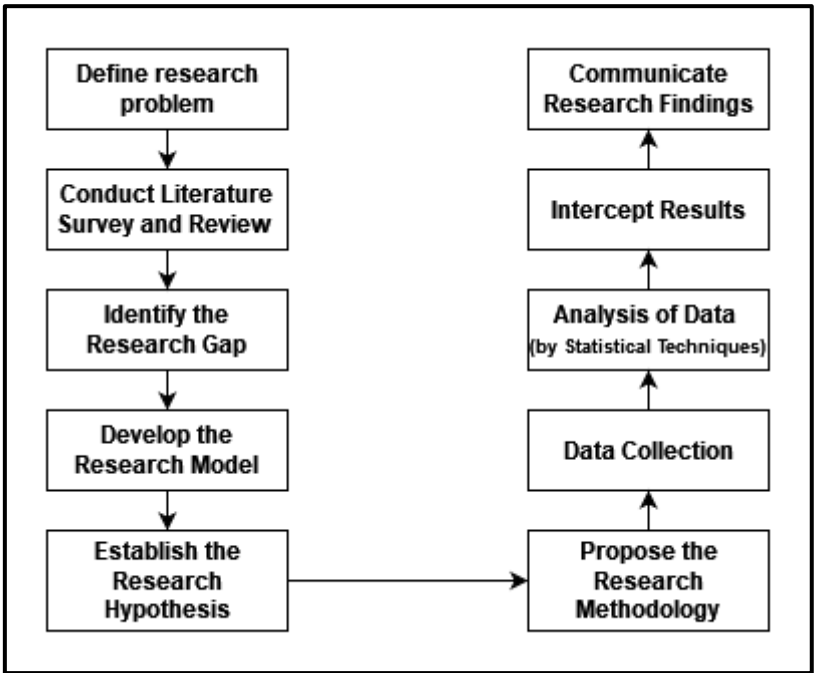

Figure 5 Research Framework

7.2 Research Hypothesis

Hypothesis 1: AI- Enabled Adaptive Learning has a direct and significant impact on the E-Learning Environment.

Hypothesis 2: AI- Enabled Adaptive Learning has a direct and significant impact on Learner's Engagement.

Hypothesis 3: E- Learning Environment has direct and significant impact on Higher Education Performances.

Hypothesis 4: Learner's Engagement has direct and significant impact on Higher Education Performances.

Hypothesis 5: Significant relationships exist between AI- Enabled Adaptive Learning, E-Learning Environment and Higher Education performances.

Hypothesis 6: Significant relationships exist between AI- Enabled Adaptive Learning, Learner's Engagement and Higher Education Performances.

Hypothesis 7: Significant relationships exist between AI- Enabled Adaptive Learning, E-Learning Environment, Learner's Engagement and Higher Education Performances.

7.3 Variables for Research Model

The analysis matrix for AI enabled Adaptive learning for E-Learning platforms could help to measure the appropriateness and relevance of the technology to improve the learner's performance and engagement.

Table 3: Analysis matrix for Adaptive Learning for Online Platform

Analysis Matrix for Adaptive Learning for Online Platform		
Key Determinant Factors	**Learner's Performance**	Grades
		Test Scores
		Learner's Progress
		Understanding of Course Material
	Learner's Engagement	Time on Task
		Real Time Feedback
		Interaction with Learning Material
		User Experience
	Learner's Adaptiveness	Level of Personalization
		Responsiveness to learner's performance and Lerner's Behaviour
		Adaptation Speed of Learner

		Quality of Feedback and Time Schedule
	Online Environment	User Interface and level of Interactive Learning
		Interactive Course Design and Course Material
		Appropriate Technology Tools and Learning Platforms
		Accessibility and Usability of Learning Environment

The proposed research model is included four components for the research. They are as follows: -

- AI-Enabled online learning approach
- E-learning ecosystem or environment
- Learner's engagement
- Learner's performance

The model includes the following variables: -

Table 4: Types of Variables used in research

Types of Variables used in Research		
Type of Variable	**Name of Variable**	**Key Factors**
Independent Variables	Personalization	• Individual learner's learning needs • Individual learner's learning experiences • Individual learner's learning preferences • Individual learner's learning style • Individual learner's learning style
	Feedback	• Type of Feedback • Frequency of Feedback • Quality of Feedback
	Interactivity	• Level of Interaction between learner and e-learning platform
	Content Delivery	• Approaches use to deliver the content to the Learners
Dependent	Learner's Engagement	• Level of Learner's Interest

Variables		• Learner's attention during the learning process • Learner's Involvement during the learning process • Learner's Participation
	Learner's Performance	• Level of academic proficiency developed by the learner from the learning process • Learner's academic achievement from the learning process • Retention of Knowledge by the Learner
Mediating Variables	E-Learning Environment	• Environment to interact with learners
	Motivation	• Learner's Motivation of engagement during learning process
Moderating Variables	Technology	• Technology to deliver academic content and help learner for online learning
	Prior Knowledge	• Prior knowledge of subject may improve the effectiveness of learning

The research model is fabricated to test the relationships between the independent variables, dependent variables, mediating variables and moderating variables. The inter-relation map between major factors could be presented as follows: -

Variables	**AI-enabled features**	**Learner engagement**	**Learner satisfaction**	**Learning outcomes**
AI-enabled features		**Associated**	**Associated**	**Associated**
Learner engagement	**Associated**		**Associated**	**Associated**
Learner satisfaction	**Associated**	**Associated**		**Associated**
Learning outcomes	**Associated**	**Associated**	**Associated**	

8. Statistical Tools

Statistical tools (Central Tendency, ANOVA, t-Test, Correlation Analysis and Regression Analysis) could be used individually or in combination to conduct the extensive analysis of collected data sets related to AI-enabled adaptive learning for e-learning platforms associated with learner's engagement and performance.

9. Sample

The group of learners refers as sample and adopted for the study. Sample represented the group of interest and selected from the population in unbiased manner. The identified sample in proposed research is from higher education institutions of Uttarakhand or different geographic locations of Uttarakhand or could be random sample of learners from population of higher education learners.

10. Sampling Size

The number of higher education leaners are selected for research referred as sample size. The size of higher education learners or online learners are selected for study through the statistical tools and size of sample should be large enough for statistical significance. The size of sample should not so large that it becomes uncontrolled or unmanageable.

11. Sampling Techniques

Sampling Techniques term to approach used to choose the higher education online learners for the research. There are some of the techniques which will be used for the sampling from the specific population.

- Random Sampling: It is method of selecting online learners from population randomly.
- Stratified Sampling: This method includes the divide of population as per specific attributes (such as age, gender, academic level) and selecting online learners from each specific subgroup.

- Cluster Sampling: This includes e-learning learners from the population as clusters (such as subject domain, university).

Table 6: Sampling Techniques

Sampling Techniques	Sampling Units	Factors to Consider during Sampling	Statistical Analysis
Simple Random Sampling	Learners experienced different e-learning or online platforms	• Large learner population • Homogeneous learner population • No prior knowledge about learner population • Learners must be from higher education of uttarakhand	• Descriptive Statistics • Inferential Statistics • Correlation Analysis • Regression Analysis

10. Survey Tools

Survey tools are used to collect data from group of learners and instructors about their experience with the use of AI enabled adaptive online learning platform. The survey tool Google Forms (https://www.google.com/forms) will be used to gather data from the samples.

11. Statistical Analysis Software

The Software would be used in proposed research for the statistical analysis of collected data from the population of online learners' data.

12. Expected Outcome of the Research

The expected outcome of proposed research may be as follows: -

- Identification of key factors that influence to learner engagement and learners performance in AI-enabled adaptive learning e-learning platform. (Such as design of e-learning platform, learning content, learner's prior knowledge about subject, learning objective, learner's interaction with learning environment)
- Analysis of relationship and level of correlation between learner's engagement and learner's performance
- Assessment of effectiveness of AI-enabled adaptive learning e-learning platform to improve learner's engagement and learner's performance.
- The outcome may include to the theorical framework of AI-enabled Adaptive Learning for higher education learners through the online learning.

The expected research outcome could slightly vary based on research problem, research methodology and research design.

15. Proposed Chaptalisation of Research

The chapter outline for the proposed research could be as follows: -

Table 7: Chapter Details

Chapter 1: Introduction	• Background study of Research Topic • Significance of Research Topic in present scenario • Objective and Scope of Proposed Research
Chapter 2: Literature Review	• Overview about the AI-enabled adaptive learning e-learning platforms for Higher Education Learners from various research papers, conferences, and web sources

	• Theoretical study of available framework of AI enabled adaptive learning and AI enabled E-learning platforms • Related studies of various topics- Adaptive Leaning, Learners Performance, Learners Engagement • Interpretation of Research Gaps • Formalization of Research Problem
Chapter 3: Research Methodology	• Fabrication of Research Design and Research Approach • Sampling • Sample Size • Gathering of Data • Data Analysis
Chapter 4: Results	• Descriptive Analysis of Results • Analysis of Learners engagement • Analysis of Learners Performance • Interpretation of relationships between different factors
Chapter 5: Discussion	• Interpretation of Results • Limitations of proposed research • Future possible research directions in this research
Chapter 6: Conclusion	• Complete summery of Key findings • Recommendations
References	• Bibliography (APA Format)

This proposed chapter outline is providing the general arrangement of thesis, despite this the

specific contents of each chapter may be slightly change depending on research questions, methodology, and findings of the research study.

16. Month wise plan of work

S.No.	Activities	Month-Year													
		Mar-23	Apr-23	May-23	Jun-23	Jul-23	Aug-23	Sep-23	Oct-23	Nov-23	Dec-23	Jan-24	Feb-24	Mar-24	Apr-24
1	Thesis Propsal Defense														
2	Extended literature Review														
3	Questinnaire Design														
4	Pilot Test														
5	Data Collection														
6	Data Prepration														
7	Data Analysis & Result														
8	Report writing: Chapter 1														
9	Report writing: Chapter 2														
10	Report writing: Chapter 3														
11	Report writing: Chapter 4														
12	Report writing: Chapter 5														
13	Thesis Writing, Publications and Other Requirements														
14	Thesis Submission														

Figure 6: Monthwise Plan of Research work

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